THE DIACOPTIC METOD APPLICATION FOR COMPLICATED ELECTRICAL CIRCUITS DIAQNOSTICS

R.A.Muradova, E.R.Bakhisheva, I.R.Muradov

Azerbaijan State Oil Academy ,Baku, Azerbaijan

ABSTRACT

The paper proposes one of the diacoptic diagnostics methods for complicated electric circuits (hundreds of nodes) analysis. This method minimizes the number of measurements during diagnostics as well as the number of mathematics calculations during obtained data processing.

Keywords: diacoptic metod, electrical circuit, mathematics calculation

I. INTRODUCTION

When complicated electrical circuits consist of nodes are under diagnostics one should minimize the number of experimental measurements and the number of mathematics operations as well. It's conditioned by limited period of diagnostics problem solution as well as computer's restricted possibilities. Besides, it's necessary to provide the acceptable precision of diagnostics problem solution. Indeed, from one hand, according to method of node resistances voltages of nodes which are electrically remote from the node with setting unit current become low and comparable with measurements errors. From the other hand, there are some technical difficulties in experimental investigation carrying out for geometrically remote parts of circuit. It leads to reduction of initial experimental information quality.

Further difficulties in the matter of large-scale matrix working up aggravate the situation.

To avoid above- mentioned problems during complicated circuits diagnostics experimental and calculation stages must be carried out "step by step" on the basis of diacoptic principles.

II. MAIN TEXT

Let's pick out Π_1 sub circuit from complicated electrical circuit (fig.1a) and diagnostic it. For this purpose one ought to number the nodes of circuit rest part bordered with Π_1 sub circuit (0,1…k) as well as the nodes of Π_1 sub circuit (k+1,k+2,…k+n) picked out. Let's consider the whole circuit as a multi-port Π_1 with boundary nodes 0,1… k+n (fig.1,b) applicable for node resistance method.

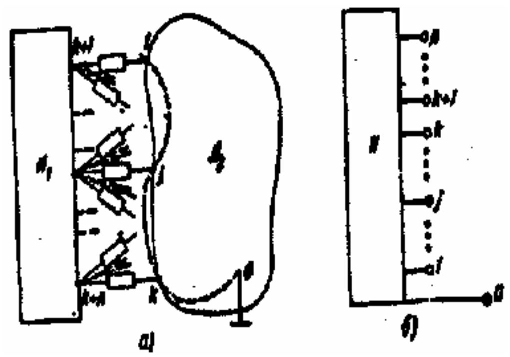

Fig.1

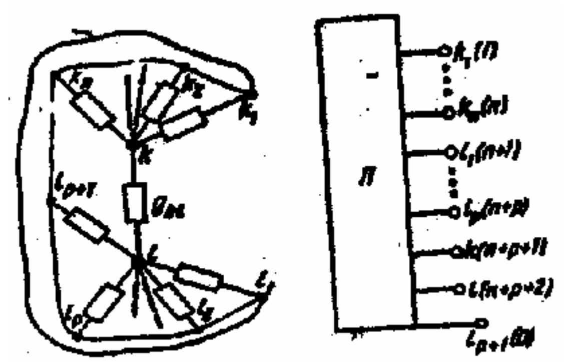

Fig.2

According to this method on the base of experimental data matrix of node resistances

$Z = \{Z_y\}_{k+n,k+n}$ is drawn up. The conversion of that matrix let us to get the matrix of node conductance $Y = \{Y_y\}_{k+n,k+n} = Z^{-1}$ of the multi-port. To carry out the calculations more rationally let's represent Y matrix in block form:

$$Y = \{Y_y\}_{k+n,k+n} = \begin{vmatrix} Y_{11} Y_{12} \\ Y_{21} Y_{22} \end{vmatrix}_n^k = \begin{vmatrix} Z_{11} Z_{12} \\ Z_{21} Z_{22} \end{vmatrix}_n^k$$

Elements of sub matrix Y from matrix Y do not correspond to conductance of initial circuit branches but correspond to parameters of equivalent multi-port replaced by the sub circuit with non-numbered nodes. We must only operate with non-diagonal elements of down-right sub matrix Y_{22} from matrix Y because they unknown values of sub circuit Π_1 branches conductance

$$g_{k+1,k+i} = \left|Y_{k+i,k+j}\right|, ij = 1,2,...n, i \neq j$$

That's why there's no need to calculate the whole matrix Y. Sub matrix Y_{22} can be found by well-known formulae of matrix block conversion:

$$Y_{22} = \left[Z_{22} - Z_{21}Z_{11}^{-1}Z_{12}\right]^{-1}$$

It's more useful to apply the modified method of node resistances for sub matrix Y_{22} elements calculation. In this case the number of measurements in experimental part of investigation will be decreased because for sub matrix calculation we won't use sub matrix elements.

The diagnostics problem can be solved analogously for any sub circuit of circuit considered. Thus, calculating parameters of individual sub circuits step by step one can solve the general problem of complicated circuit diagnostics. Choosing the way of complicated circuit separation into sub circuits it is wishful to take into consideration the point of experiment's technical realization simplicity, for instance, separate sub circuits shouldn't contain geometrically remote nodes. Sometimes the way of circuit separation is conditioned by necessity to provide high precision of problem solution for some parts of circuit. If "step by step " diagnostics is caused by impossibility of large-scale matrix working up in calculation stage the way of separation is based on restriction of sub circuits dimension by number depending on the volume of computers memory.

The method considered allows to reduce the number of experimental and calculation operations. The limit case of above-mentioned decomposition is when separate branches are considered as sub circuits. In doing so, diagnosed circuits conductance calculation is carrying out on "branch by branch " succession. Let's analyze that case in detail.

Let's calculate g_{k1} conductance of the branch between k and l nodes in electrical circuit shown on fig.2 a. Circuit nodes connected with k and l nodes are marked as $k_1, k_2, ...k_n$ and $l_1, l_2, ...l_{p+l}$ correspondingly. Let's replace the circuit relatively to chosen modes by equivalent multi-port (fig.2,b) and renumber the nodes (nodes' new number are given on fig.2,b within brackets).

Using method of node resistances one can calculate Z matrix for Π multi-port with further $Y = \{Y_{i,j}\}_{n+p+1,n+p+2}$ matrix calculation. In this case conductance can be found as follows:

$$g_{k1} = \left|Y_{n+p+1,n+p+2}\right| \quad \text{or} \quad g_{k1} = \left|Y_{n+p+2,n+p+1}\right|$$

Calculating conductance's on "branch by branch " succession one can obtain solution of the diagnostics general problem. The number of measurements for such diagnostics experiment in this case decreases as well as matrix scale.

III.CONCLUSION

The method considered allows to reduce the number of experimental and calculation operations. The limit case of above-mentioned decomposition is when separate branches are considered as sub circuits.

REFERENCES

1. *Kuliyev H.M., Muradova R.A.* Fully diagnostic determination of electric circuit parameter. Patent № I-20000200, 29.09.2000, Azerbaijan (in Russian).
2. *Muradova R.A.* Researches of some methods of ferromagnetic particles deposit in dissimilar fields. Power Engineering Problems, № 2, 2003, p.104-106, Elm, Baku (in Russian).
3. *Muradova R.A.* Mathematical model of electromagnetic filtration process of technological liquids and gases. News of Azerbaijan high technical educational institutions, № 2 (30) , 2004, p.66-68,Baku (in Russian).